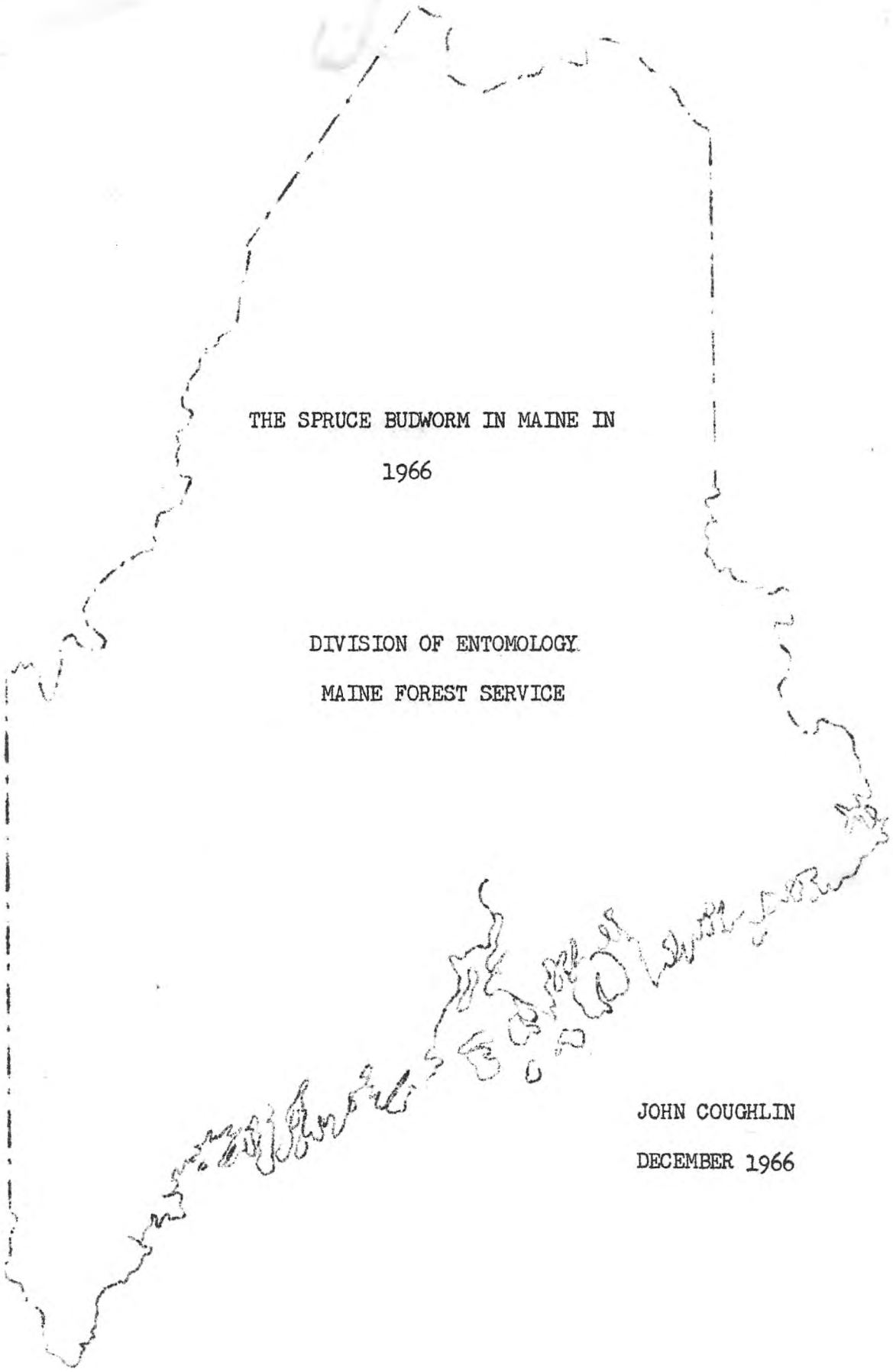
THE SPRUCE BUDWORM IN MAINE IN 1966

DIVISION OF ENTOMOLOGY
MAINE FOREST SERVICE



JOHN COUGHLIN

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1. INTRODUCTION

There have been no spray operations against the spruce budworm in northern Maine since 1964. Budworm populations have remained low in the area treated in 1963. The 1964 operation was essentially a "mop-up" treatment, spraying peripheral areas for the most part, plus an area which would have been sprayed in 1963 had it not been desirable to reserve the area for experimental use. Since 1964 the Entomology Division has pursued a policy of intensive surveys to check the budworm infestation for signs of recovery or resurgence.

Field work concerned with these intensive surveys has been continued from laboratories at Portage Lake and Sinclair. All the regular survey collections have been continued with areas of negligible infestation being covered by the Forest Fire Ranger forces and the various light trap stations. Collections sent to Portage, Sinclair, or Augusta from which spruce budworm were obtained in 1966 are shown cartographically (Figure 1).

Collections of fir foliage made throughout the budworm-infested area during the early larval and late larval-pupal periods yielded sufficient budworm larvae to follow insect development and indicate seasonal survival. Material from these collections was used in dissection and rearing work for parasitism estimates, as part of a continued check on natural control forces.

The spruce budworm field work continues to be the principal project for many of the Maine Forest Service Entomology staff during the months of May, June, July, and August. Involved during 1966 have been entomologists Douglas Stark and Hubbard Trefts. Biologist Horace E. Bell and Forest Insect Rangers James A. Holmes, Maynard Atwood, Rex McBreairty, John Lavigne, Larry St. Peter, James McMullen, and Lendon Robinson have spent a large part of the summer field season on the project. The work is under the direction of John Coughlin.

Light trap identifications have been made by Dr. A. E. Brower at the Augusta laboratory. Valuable advice and suggestions continue from Dr. William E. Waters and Gordon Mott of the West Haven, Conn. laboratory of the U. S. Forest Service. The Great Northern Paper Co. has continued to provide a portable building for a laboratory at Portage Lake.

2. DEFOLIATION BY SPRUCE BUDWORM IN 1966

After budworm feeding was essentially completed, two separate but complementary aerial surveys were made for fir discoloration. The entire infested area was surveyed by a line-strip method with machine recorded observations and defoliated areas were also sketch-mapped. Ground observations of defoliation were made in addition during the egg mass survey later in the season. Data from these sources have been combined to produce the map presented in Figure 2.

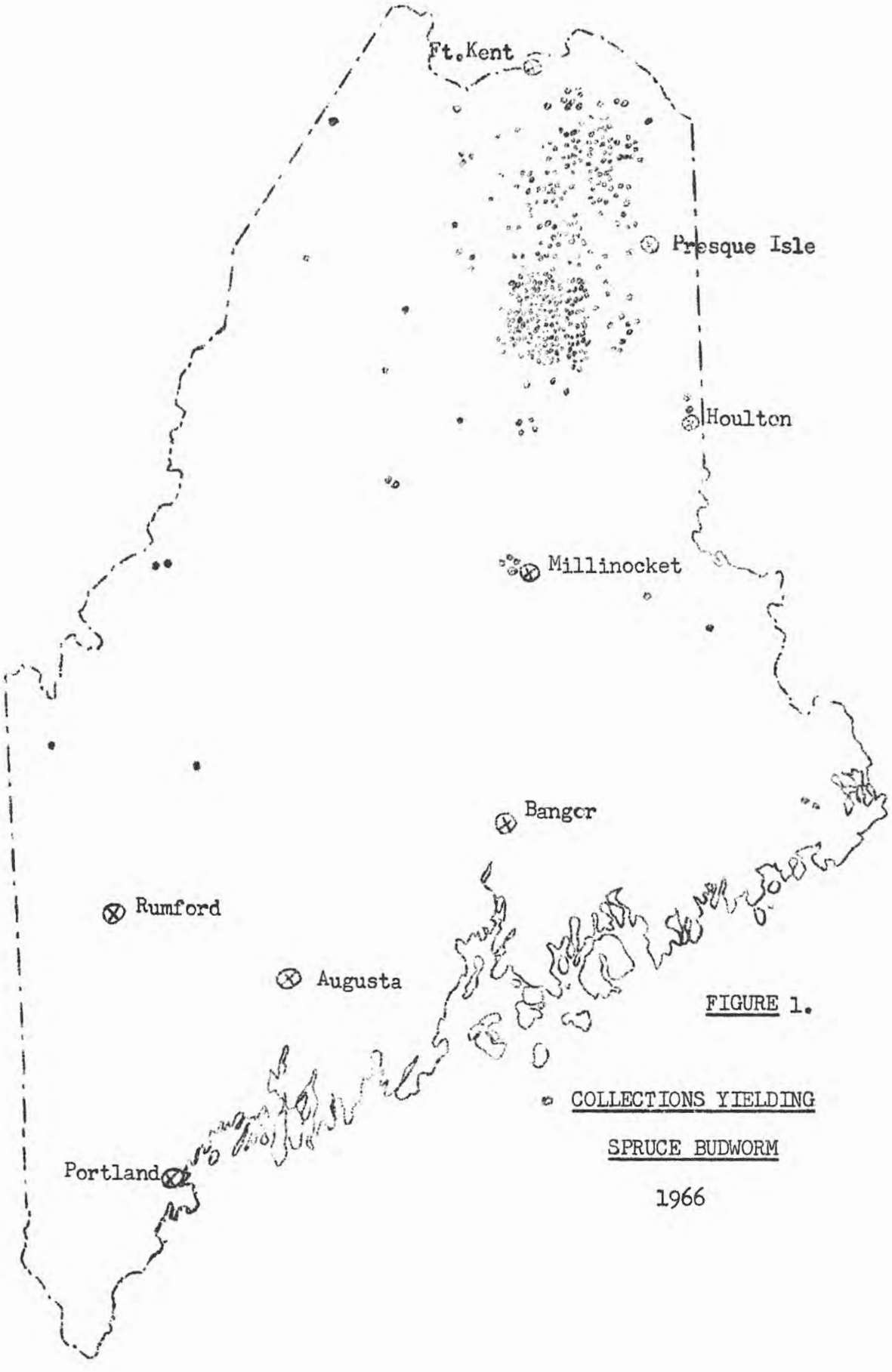

FIGURE 1.

COLLECTIONS YIELDING

SPRUCE BUDWORM

1966

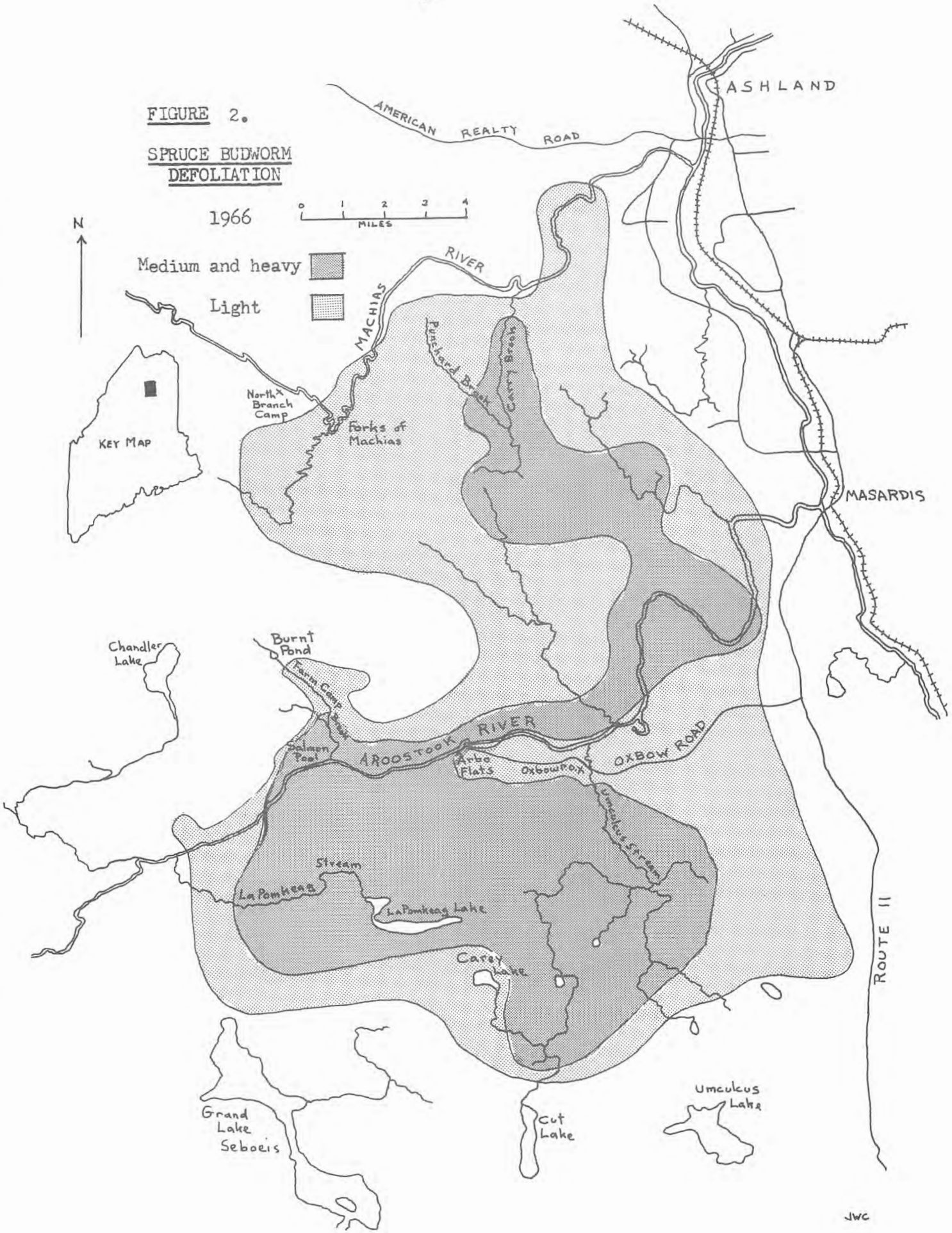
FIGURE 2.
SPRUCE BUDWORM DEFOLIATION
1966
0 1 2 3 4
MILES
N
Medium and heavy
Light
KEY MAP
ASHLAND
AMERICAN REALTY ROAD
MACHIAS RIVER
Punchard Brook
Canty Brook
North Branch Camp
Forks of Machias
MASARDIS
Chandler Lake
Burnt Pond
Farm Camp Brook
Salmon Pool
ARoostook RIVER
Arbo Flats
Oxbow Pt.
OXBOW ROAD
Umcolcus Stream
Stream
LaPomkeag
LaPomkeag Lake
Carey Lake
ROUTE 11
Grand Lake Seboeis
Cut Lake
Umculcus Lake
JWC

The defoliation of 1965 south of the Oxbow road and the Aroostook River in T8R5 T8R6, T8R7, T9R5, T9R7 and Oxbow was again evident in 1966 with some intensification and a moderate extension on all sides, especially along the Aroostook River and Farm Camp Brook, toward but not as far as Burnt Pond. Some trees, especially along the west side of Umculcus Stream, below the Oxbow Post Office, are now in poor condition as a result of several years of defoliation. However, this condition is by no means continuous or uniform, being broken up by areas of trees considerably defoliated in 1966 but not seriously so previously.

The 1965 defoliation south of the Machias River and west of Masardis village along Carry and Punchard Brooks intensified in 1966. There were already some trees in poor condition in this area. This defoliated area is now contiguous with the Oxbow area as a result of 1966 extensions along the Aroostook River.

West of the Forks of the Machias and south of North Branch Camp, the defoliation was less serious in 1966 but was connected with the Carry Brook area by light defoliation. There were scattered spots of medium defoliation in this area but most defoliation was light in 1966.

No defoliation was observed along Hewes Brook, north of the Fish River in T14R7 where defoliation was observed in 1965. In fact, there were no other areas of defoliation picked up in 1966.

3. THE EGG MASS SURVEY

Greater attention was directed toward the defoliated areas during the egg mass survey in order to delineate the problem. Collections of fir foliage were continued in the non-defoliated, more lightly infested areas as well. A map of the 1966 egg mass survey is presented in Figure 3.

It is convenient to divide the general budworm-infested area into two subareas (Figure 4) based on both the defoliation surveys and the egg mass survey:

1. The heavy population areas -- both north and south of the Oxbow road which in both 1965 and 1966 were seen to support most of the budworm population and experience most of the defoliation.

2. The light population areas -- all other areas, generally having light to negligible budworm populations.

The heavy population area is moderately well defined and consists of the region from just north of Grand Lake Seboeis and Umculcus Lake northerly to the Machias River and easterly to Route 11. This would include generally the OXBOW and OXBOW - SOUTH, and the Carry and Punchard Brooks section of the 1965 infestation, together with areas in between and around the perifery.

The 1965 egg mass survey data were re-examined and compared with the 1966 data for both the heavy and light population areas. Within the heavy population area, the number of budworm egg masses per 15-inch fir tip sample increased by a factor of 2.32. The outlying or light population areas declined by a factor of .54. (Table 1 shows trends for 1965-1966)

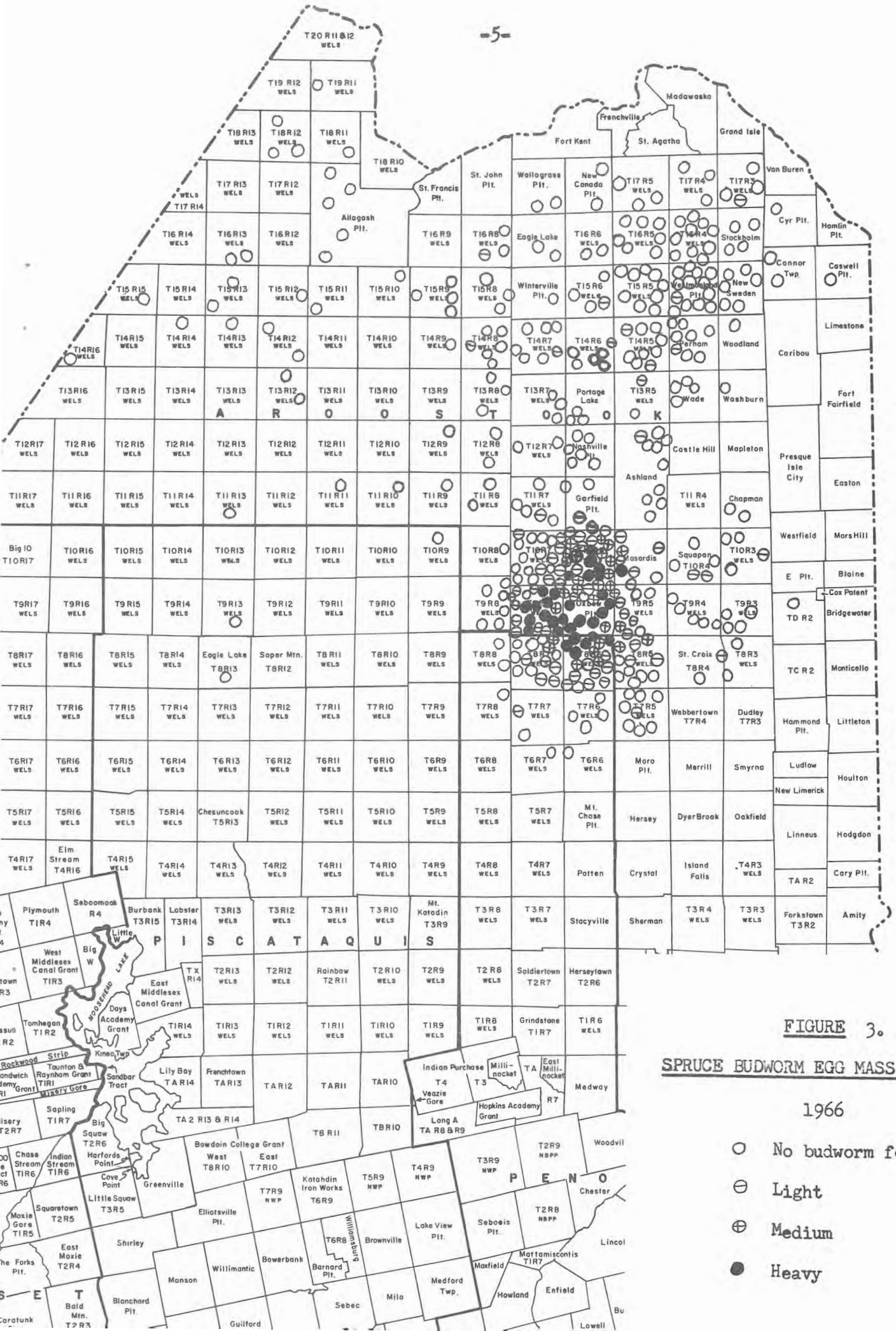

FIGURE 3.

SPRUCE BUDWORM EGG MASS SURVEY

1966

- ○ No budworm found
- ⊖ Light
- ⊕ Medium
- ● Heavy

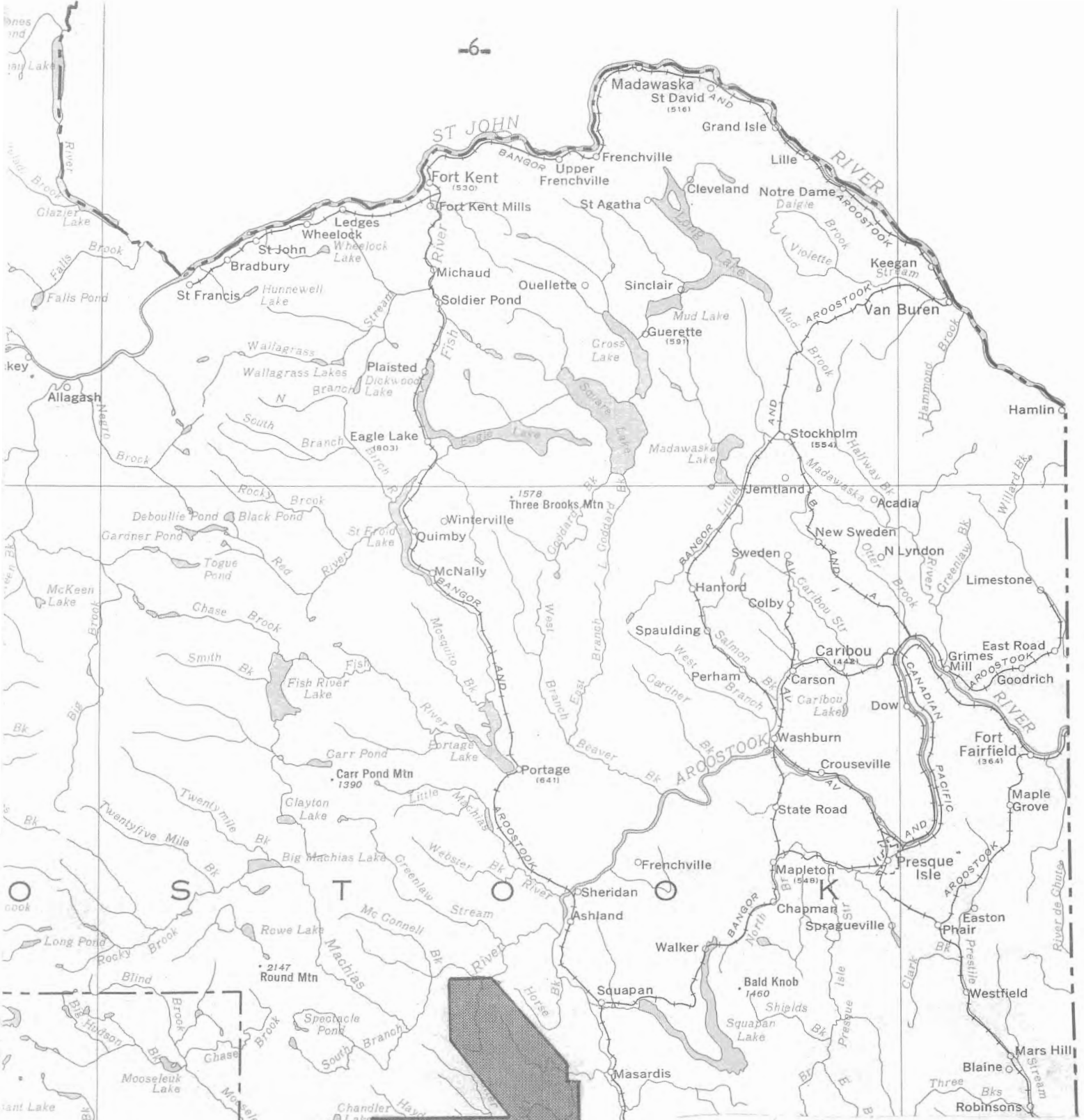

FIGURE 4.

HEAVY AND LIGHT POPULATION AREAS

Heavy population:

Light population: all other areas

0 5 10
MILES

TABLE 1. Trends in spruce budworm egg mass populations, 1965 - 1966

	Average number of egg masses per 15-inch fir tip (number of sample points indicated by brackets)		
	1965		1966
1. Heavy population areas	.435 (55)		1.011 (77)
	(Trend Index [1].	2.32)	
2. Light population area	.028 (263)		.015 (239)
	(Trend Index	0.54)	

[1]. Ratio number of egg masses -- 1966/1965

4. SPRUCE BUDWORM AT LIGHT TRAPS IN 1966

Light traps were operated at 29 locations during 1966. All material was sent to Augusta for examination. Results are shown in Table 2. The catches suggest a very slight increase in the more westerly budworm populations but otherwise there were no unusual catches. The trap at T9R5 Oxbow Road is near the eastern edge of the heavy population area and would probably have captured more budworm moths had personnel problems not intervened. The light trap collections are included in the collections shown in Figure 1. A map showing the location of the light trap stations is presented in Figure 5.

5. NATURAL CONTROL FACTORS

Most of the data concerning the effects of natural control factors during 1966 have come from the heavy population area. Elsewhere budworm were relatively scarce. The remarks in this section should be considered as referring largely to the heavy population area.

Weather and parasite conditions were more favorable for the spruce budworm in 1966 as compared to 1965. In addition, an abundance of fir flowers aided the budworm in rapid development.

There were already large numbers of budworm larvae in the 4th instar by the time regular collections were started on the 26th of May. Some larvae had reached the 6th instar by the 3rd of June although the peak of the 6th did not occur until the 16th (Fig. 6). There was a greater spread in development as many collections yielded individuals in quantity from three or more different instars. This probably reflects differences in budworm development rates on flowering versus non-flowering trees. Both yielded sample material but no special effort was made to separate flowering from non-flowering tree material.

The favorable conditions for the spruce budworm in 1966 are reflected in a comparison of survival in recent years (Table 3). Survival in 1966 was near the level of 1963, which was considered a favorable year for the budworm, at least in untreated areas. 1964 and 1965 had been progressively less favorable, a circumstance reflected in lowering survival.

Parasitism in the early larval stage from Apanteles, Glypta, and Horogenes was considerably lower in 1966 than in 1965 (Table 4).

Late larval-pupal parasitism was also lower in 1966 (Table 5).

Aggregate early and late larval-pupal parasitism was 32.9% in 1966 compared to 49.4% in 1965, 30.1% in 1964, and 8.7% in 1963.

TABLE 2. SPRUCE BUDWORM IDENTIFIED FROM LIGHT TRAP COLLECTIONS DURING 1966

Dates of Collection *

LIGHT TRAP LOCATION	JULY 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	25	26	29	31
Kingfield				1																		
Lower Cupsuptic T4R3								1														
Eustis																						
T2R4NBKP-Pittston																						
Dennistown											1					1						
T5R16 Russell Mtn.																						
T8R19 (Somerset County)																						
T8R13-Tramway																						
T13R12-Round Pond Mtn.																						
T15R13-Big Black River																						
T18R12 Rocky Mtn.																						
T17R11 Dickey																						
St. Francis																						
T11R8 Round Mtn.																						
T17R5 Cross Lake					1				1		1											
T15R9 DeBoulie Mtn.															2		3		3			
Fort Kent Customs																						
Madawaska																						
Fort Fairfield																						
Houlton			2																			
T9R5 Oxbow Rd								7	(Light trap not operated									)	1	1	1	
Squaw Brook (Fish Hatchery)																						
T3R12 Chesuncook Dam	1		1																			
Long A (Millinocket)		3		3													1					1
Shin Pond								4	2		3					2						
Topsfield									1													
Enfield																						
Marion					1	1																
Vanceboro																						

* For example, July 10 means the night of July 9-10.

FIGURE 5.

LIGHT TRAP LOCATIONS

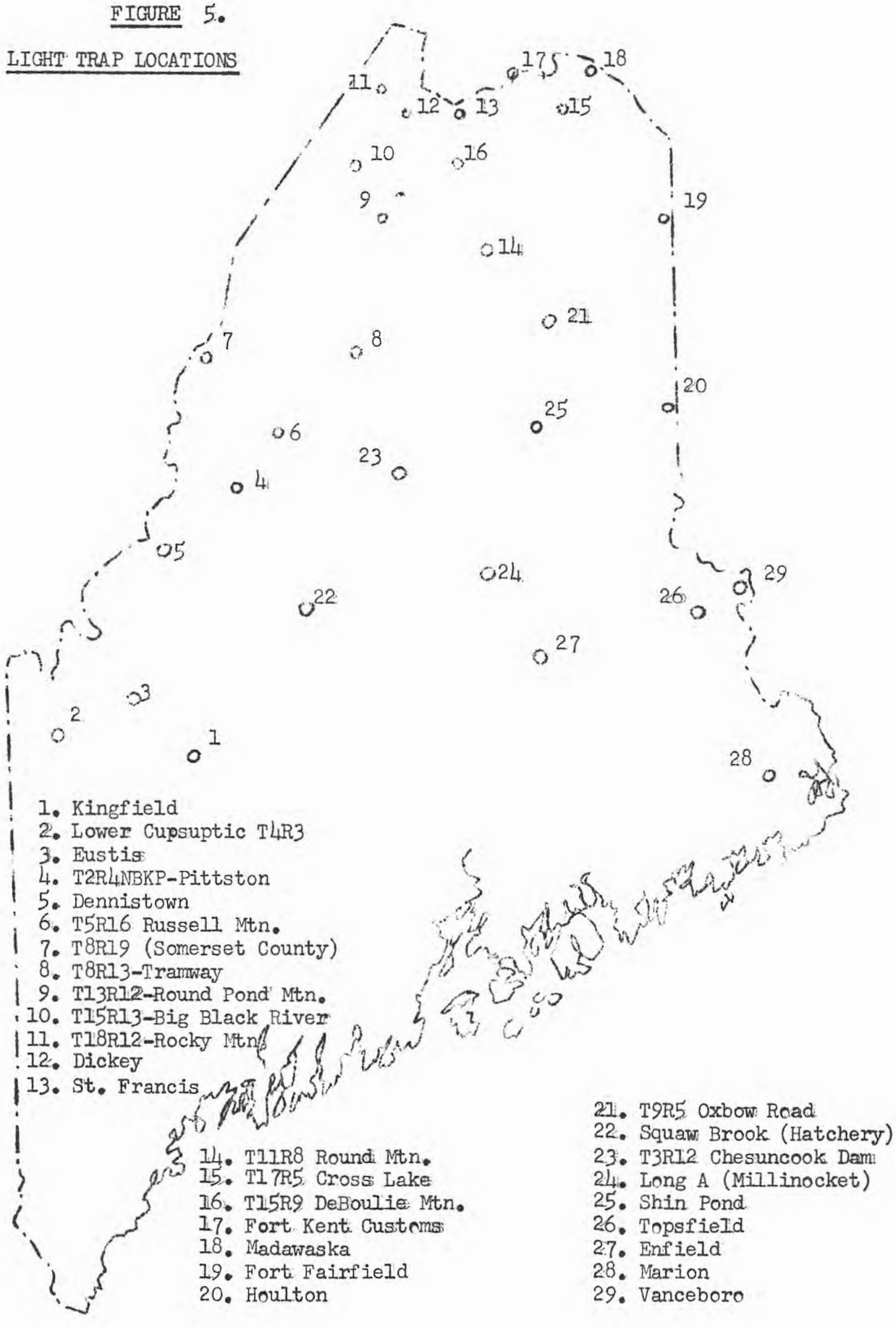

FIGURE 6. Spruce Budworm Development in 1966, From material collected at Oxbow.

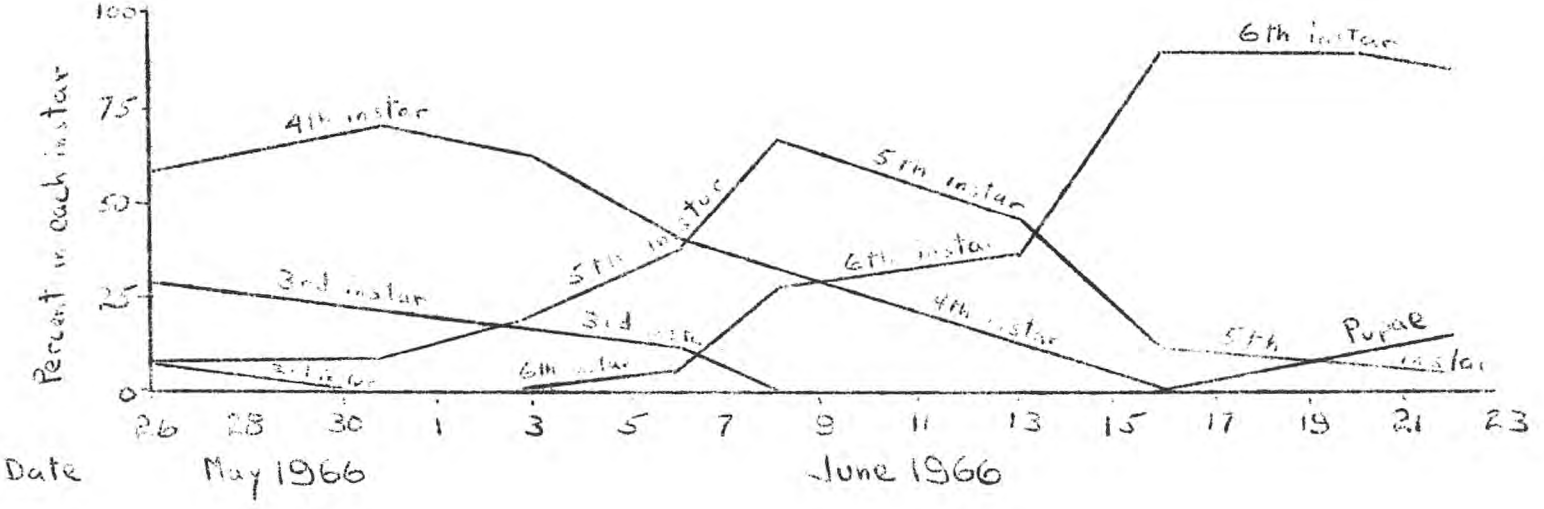

TABLE 3. Spruce Budworm Survival[1]. 1963-1966 (No. of sample points indicated in brackets)

1966		
	Heavy population areas	.660 (21)
	Light population areas	.641 (25)
1965		
	Heavy population areas	.558 (9)
	All areas taken together	.540 (102)
1964		
	All areas taken together (untreated)	.605 (45)
1963		
	All untreated areas	.665 (15)

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1. Survival = $\frac{\text{number of large larvae and pupae}}{\text{number of small larvae}}$

TABLE 4. Spruce budworm parasites present in early larval collections, 1966

No. of collections	72
No. of larvae dissected	1842
No. of *Apanteles* sp. present	173
No. of *Glypta* sp. present	112
No. of *Horogenes* sp. present	7
No. of unidentified parasites	12
Total number of parasites	304
percent parasitized	16.5

(Percent parasitized in 1965 25.3
" " " 1964 19.6
" " " 1963 14.)

TABLE 5. Parasites of late larvae and pupae, 1966

No. of collections	82
Corrected [1] number of larvae and pupae reared	1636
No. of Itoplectis sp. recovered	3
" " Ephialtes " "	14
" " Phaeogenes " "	0
" " Meteorus " "	75
" " Actia " "	3
" " Agria " "	6
" " Aplomya " "	46
" " Lypha " "	62
" " Omotoma " "	26
" " Phorocera " "	40
" " Phryxe " "	31
" " Undetermined parasites recovered	15
Total number of parasites recovered	321
Percent parasitized	19.6

(Percent parasitized in 1965 32.3
" " " 1964 13.1
" " " 1963 8.7)

1. Correction is made by discounting early larval parasites recovered and those dead of unknown cause or missing during rearing.

Egg mass parasitism continued to decline from the high of 1964[1] to 6.5% in 1966.

Although there were little data on the effects of these natural control factors in the light population area, the downward trend of egg mass populations (Table 1) and the lower survival (Table 3) in the now lightly infested areas would suggest a degree of control not shared by the heavy population areas north and south of the Oxbow Road.

6. EXPECTED 1967 CONDITIONS

The light population area is in good condition for 1967. Light to negligible defoliation in 1966 and indications of a declining spruce budworm population trend in recent years would seem to justify considerable optimism. Throughout most of the area of recent concern, the budworm has not recovered from the effects of the 1963-64 spray operations.

In contrast, the much smaller Oxbow or heavy population area harbors an active infestation with considerable tree damage in prospect. The 1966 natural control data, applying largely to this area, give no promise of early relief. Coupled with the danger of tree damage, is the real possibility of re-infesting the light population area and jeopardizing it anew. Most of the heavy population area south of the Aroostook River has never been sprayed. While there have been measurable budworm populations in parts of this area in the past, the infestations have been lighter and more irregular and never met the criteria for treatment. However, much of the region north of the river has been treated previously.

During the two seasons when there were no spray operations, there emerged a picture of declining infestations over most of the previously infested area but an increase and consolidation of the infestation in the limited Oxbow, Carry and Punchard Brooks section. Entomologists of the Maine and U. S. Forest Services met in October to consider the data. They recommended that the heavy population area be treated in 1967. While exact boundaries are not yet decided upon, the control recommendation would involve some 100,000 acres, centering on the Oxbow Road, west of Route 11 and south of the Machias River.

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1. Egg parasitism: 1964, 27.4%; 1965, 18.4%

7. SUMMARY

1. There have been no spray operations against the spruce budworm in Maine for two consecutive seasons.

2. Defoliation in 1966 was essentially restricted to the Oxbow, Carry and Punchard Brooks section.

3. Heavy populations continue in an area both north and south of the Oxbow Road which in both 1965 and 1966 supported most of the budworm population and experienced most of the defoliation.
The number of budworm egg masses per 15-inch fir tip sample from this area increased in 1966 by a factor of 2.32 compared to 1965.

4. All other areas, including most of those previously infested, declined in infestation by a factor of .54 in the number of budworm egg masses per 15-inch fir tip sample.

5. There is no indication that natural control factors are likely to be effective in the heavy population area although they may be influencing the infestation in the light population area.

6. Recommendations have been made to treat the heavy population area with a control operation of about 100,000 acres for 1967. All other areas are in good condition with light populations expected.

8. CONDITIONS IN ADJACENT CANADIAN PROVINCES[1].

Maritime Provinces

Some 1.97 million acres in central New Brunswick were sprayed in 1966 to protect the foliage crop from damage by the spruce budworm. Very little defoliation was observed within the treated area, although patches of moderate and severe defoliation were observed in several widely scattered areas outside the sprayed area. The annual survey for budworm egg masses revealed that the centers of heavy infestation are more widely dispersed than in recent years and only 1.3 million acres are severly infested. The outbreak is still spread across the central part of the province however, and has extended to the southeast.

In Nova Scotia, there were significant increases in the numbers of larvae found in old field white spruce near Antigonish and along the western shore of Cape Breton Island. Low numbers of egg masses were found at 20 locations in the western part of the province. Some light defoliation was also observed on Prince Edward Island, and egg masses were found at nine locations.

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1. Information from D. R. Macdonald, Canada Department of Forestry and Rural Development, Fredericton, N. B.